Reply To Examiner's Remarks

Claims 1-7, as amended, and new claims 14-17 are presented for consideration.

An amended Figure 2, including the caption "FIG. 2 (Prior Art)" as required by the Examiner, is included herein.

The Applicant hereby confirms cancellation of claims 8-13, pursuant to a claims restriction received on or around 24 March 2004.

The Examiner requires that the steps numbered (1) through (12) recited in claim 1 be redesignated as steps (a) through (l). Claim 1 is amended herein to implement this requirement and to add one step.

The Examiner rejects claim 1-7 under 35 U.S.C. §101 as covering non-statutory subject matter. Claims 1-7 are amended, and new claims 14-17 are added herein, to recite that the invention is applied to "a computer implemented method for use in engineering applications, including but not limited to optimizing designs, classifying data and generating regression estimates . . . for use in at least one of optimizing a design, controlling a physical or chemical process, classifying data and generating regression estimates for a collection of the data . . .".

New claim 14, dependent upon claim 1, recites that the use in engineering applications comprises design of one or more aircraft components, such as airfoils, as discussed on pages 1, 5, 13, 14, 15 and 16 of the specification. New claim 15, dependent upon claim 1, recites that the training error is computed as a sum of magnitudes of differences between a computed pressure value and a desired pressure value at each of a collection of selected locations on the airfoil. New claim 16, dependent upon claim 1, recites that the process for computing an optimum airfoil involves steps (n)-(t), as recited therein. New claim 17, dependent upon claim 1, recites that the use in engineering applications comprises design of one or more turbine or compressor airfoils.

Amended claim 1 includes language that is substantially identical to language of claim 1 of U.S. Patent No. 6,606,612, issued to the Applicant herein and another inventor, covering a closely related invention, and reviewed by the same Examiner. The Applicant believes that amended claim 1 and new claims 14, 15, 16 and 17 recite physical applications of the invention that satisfy the statutory requirements of 35 U.S.C. §101.

The Examiner rejects claims 1-7 under 35 U.S.C. 112, first paragraph, on grounds related to the Section 101 rejection. The Applicant believes that claims 1-4, as amended, and new claims 14-17 now provide appropriate language to satisfy Section 101 and Section 112.

The Examiner rejects claims 1-7 under 35 U.S.C. 102(b) as anticipated by the disclosures in a cited by Suykens and Vandewalle, I.E.E.E. Transactions on Circuits and Systems, vol. 47 (July 2000) pp. 1109-1114. Page 1111 of the copy of the Suykens et al article supplied by the Examiner is missing, but the Applicant has obtained and reviewed a copy of page 1111, together with the remainder of the Suykens et al article. The Applicant recommends that the Examiner include the page 1111 whenever this article is subsequently cited by the Examiner.

The Suykens et al article discloses use of a recurrent least squares support vector machine (LS-SVM) approach, through Eqs. (17)-(27) and associated relations, to minimize an empirical risk, set forth in Eq. (2) of the Suykens et al article. The Suykens et al recurrent model, defined in part by Eq. (17),

$$y_k{}^\wedge = f(y_{k-1}{}^\wedge, \ldots, y_{k-p}{}^\wedge),$$

depends upon previously computed optimal values $y_{k-r}{}^\wedge$ but does not depend upon previously received or provided parameter values $u_{k-1}, \ldots, u_{k-p}$, as explicitly set forth in Eq. (15). The Suykens et al article uses a recurrent SVM approach in order to reduce solution of a Lagrangian functional L, set forth in Eqs. (8) and/or (22), to

solution of a sequence of linear equations, set forth in Eqs. (23), (25), (27) and (28).

Neural network design (NND), as discussed in the subject patent application, is a design optimization method that is an extension of response surface methodology (RSM). Whereas polynomials are introduced and used to construct the response surfaces in traditional RSM, NND uses NNs and SVMs to perform this function and does not require ab initio introduction of polynomials or of any other analytic functions. NND thus allows construction of very complex response surfaces without requiring the user to specify a model.

Although NND has been developed for multi-purpose design, one version of this system focuses on aerodynamic design optimization. NND provides advantages over traditional optimization methods: (1) greater flexibility in dealing with aerodynamic design for steady and unsteady flows; (2) use of complete, or only partly complete, data sets; (3) use of combined experimental and computational data, if desired; and (4) inclusion of various constraints, and even rules of thumb, in the problem formulation.

NND provides a natural computational framework within which a succession of numerical solutions of increasing fidelity and realism can be represented and used for optimization. NND also offers an excellent framework for multi-ple objective optimization and has a potential for use in multi-disciplinary optimization.

As applied to airfoil design, a system for practicing NND may include several modules: (1) airfoil surface generator; (2) grid generator; (3) a combined neural network/support vector machine to perform experimental design and to construct response surfaces; (4) a gradient-based optimization scheme, to search for an optimal design; (5) script files for job submission and control; and (6) a

control module, to serve as a user interface and to sequence the calls to other modules.

Connection of the Suykens et al approach with an integrated neural network (NN) approach is tenuous at best. The asserted connection of the Suykens et al approach with "a recurrent neural network version," as recited in lines 7-8 of the left hand column of page 1110 of the Suykens et al article, is not developed or made explicit. One can, as the Suykens et al article implicitly but not explicitly does, introduce a "reduced" NN system in which a hidden layer and/or an output layer of the NN is limited to situations in which the inner products appear in specified forms (e.g., linear) in formulation of the NN defining relations.

If one interprets the Suykens et al approach as implicitly including an NN system, the Suykens et al approach requires set-up, processing and solution for each additional value of a recurrent variable, such as $y_k{}^\wedge$ (e.g., moving from $y_k{}^\wedge$ to $y_{k+1}{}^\wedge$). This requires serial solution of each of a sequence of NN systems; whereas amended claim 1 of the subject patent application requires only one solution of a single, admittedly more complex, NN system.

Amended claim 1, step (f), recites that at least one hidden layer output signal is used as a feature space coordinate for the SVM component. Amended claim 1, step (l), recites that at least one feature space coordinate value changes automatically in response to change of the at least one connection weight in the NN system (responding to a computed training error that is too large). Use of a hidden layer output signal as a feature space coordinate and automatic change of a feature space coordinate value are not disclosed or even suggested in the Suykens et al article.
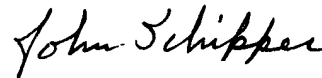
The invention recited in claim 1, as amended, of the subject patent application (1) does not rely upon a recurrent SVM, (2) relies upon set-up, processing and analysis of a single NN system, not upon serial set-up, processing

and solution of a sequence of recurrent NN systems, and (3) uses a hidden layer output signal as a feature space coordinate and provides for automatic change in at least one feature space coordinate value in response to change of at least one connection weight in the NN system.

The Applicant also believes that the further recitations in claims 15 and 16, involving more detail concerning computation of a training error and computation of an optimum airfoil, also provide patentable distinctions over the disclosures in the Suykens et al article

Thus, it would not have been obvious or anticipated, from the disclosures in the Suykens et al article, to proceed as recited in amended claim 1 and in new claims 15 and 16. Claims 2-7 and 14-17 depend upon amended claim 1 and are believed to be allowable if claim 1 is allowable. The Applicant requests that the Examiner pass the application, including claims 1-7, as amended, and new claims 14-17 to issue as a U.S. patent.

Respectfully Submitted,

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Date: 29 September 2004   John Schipper

Patent representative for Applicant